Techniques for Detection of Lanes on Roads–A Review

K.Mirunalini1
PhD .Research Scholar,
Dept of Computer Science,
Avinashilingam Institute for Home Science and Higher Education for Women
Coimbatore 641043
Email id: meeramena@gmail.com

Dr.(Mrs).Vasantha Kalyani David 2
Professor,
Dept of Computer Science,
Avinashilingam Institute for Home Science and Higher Education For Women
Coimbatore 641043
Email id: vasanthadavid@gmail.com

Abstract- Road accidents are the topmost reason for death in every country. As per media statistics, one person is been killed in the road accident for every four minutes in Asia. Road accidents are happening specifically due to miss-judgments, drowsiness, and inattentiveness to the surrounding vehicles, unsafe Lane Changes, weather conditions, potholes, speeding and not following traffic rules. A driver finds it tough to control the vehicle due to sudden potholes and bumps or sudden turns where the road signs aren't very distinguished or lacking maximum of the instances. Suppose if there is a system with integrated motion camera and an incorporated onboard computer with a vehicle, a simple driver guidance system by means of frame analysis of the movement frames can be developed and there through generating the alarm indicators as an end result so that riding can be made quite less difficult. LDWS is a system generally designed to convey an alert message to the driver once the vehicle begins to travel out of its lane boundaries on roads without a signal. In this paper, a different kind of techniques used for lane detection and identification of automobile departure to avoid unwanted lane departure has been presented.

Key words: lane detection, types of lane, benefits, limitations.

Introduction:
The fast-growing volume of traffic has an important effect on economic development but it additionally causes a huge amount of traffic accidents. A report from World Health Organization (WHO) points out that over 90% of the world’s fatalities on the roads arise in low-earnings and middle-income countries which have only 48% of the world registered vehicles. It’s been estimated that if immediate action isn’t taken towards road accidents, street traffic deaths will have an upward thrust up to the 5th main reason of death per year by 2030, resulting in an expected 2.4 million fatalities in line with the year. According to the fact, improper driving response, high speed as well as U-turn are the major causes behind the majority of those incidents. Specific measures are being taken by automotive industries to decrease the accidents, as a result an intelligent automobile safety system has been proposed with a purpose of decreasing the number of fatalities and injuries by giving warning to the unaware driver with regard to the danger. The advance driver assistance system (ADAS) presents a safe system to reduce the road accidents. The system takes an active step like cautioning the driver or takes a corrective movement to avoid an accident during the dangerous situation.

Fig 1 Advanced Driving Assistance System
A. Lane

Lane is a part of a roadway that is designed for the use of a single line of vehicles. It is used to give direction to the driver and also help in reducing traffic conflicts. For traffic in each direction, there are minimum 2 lanes at the roads and lane markings are used to separate them. Lanes are specified by road surface markings on multilane roadways and busier two-lane roads.

1.1 Types of Lanes

1) Traffic Lane: Is a lane for the movement of vehicles travelling from one destination to another
2) Express Lane: Utilized by faster-moving traffic and has less access to exits/off ramps
3) Reversible Lane: To match the peak flow direction of vehicles the lane is changed. Periods of high traffic flow are accommodated by this lane.
4) Auxiliary lane: Is a lane other than a through lane, used to split entering, exiting or turning traffic from the through traffic. In some areas, for non-moving vehicles lane adjacent to it is reserved.

B. Lane detection

The lane detection algorithm distinguishes the lane boundaries and estimates the straight line in geometry of lane. At present, two well-outlined techniques are there for performing lane recognition by making use of video that is a feature-based method and model-based method. Feature-based methods are keen on clear lane-marks and suffer from weak lane-marks, noise, and hidden objects. Model-based methods represent lanes as a form of curve model which can be determined by few vital geometric parameters. The model-based methods are less vulnerable to weak lane appearance features and noise when compared to feature-based methods. Lane detection allows one to obtain the position as well as the direction of the vehicle. In addition to lane information, areas which incorporate highways are vital to alert a driving force associated with lane departure. The lane information is generally used for tracking down other motor vehicles as well as hurdles within the route of the vehicle which could be positioned on the extra development of the barrier averting device. However, the model constructed for one scene won’t work on another scene, which makes these techniques less adaptive. Moreover, for best estimation of model parameters, an iterative error minimization algorithm set of rules ought to be carried out, which is comparatively a tedious approach.

The Lane Detection Algorithm supports various applications:

(1) **Lane departure warning** – give a warning when the vehicle is crossing the lane without any warning signal.

(2) **Lane keeping assists** – once the vehicle is crossing the lane unintentionally, automatically steering torque is implemented to stop the vehicle from exiting the lane.

(3) **Lane centering** – In this, the steering wheel is always in control to keep the vehicle in the lane centre. This application is a crucial component in autonomous driving systems.

There are different lane detection algorithms, available such as such as B-snake; Histogram based segmentation, Edge linking and Hough transform.

'C. Lane Departure Warning

The lane departure warning system (LDWS) make use of the information of the lane detection, to estimate if the vehicle is unintentionally crossing the lane boundary within the next few seconds. If a driver did not show any sign of replacing lanes, a warning is issued. The warning mechanism depends upon sensitivity – for example, this system is used to warn only when the vehicle is actually crossing the lane, or provide an early caution before lanes are crossed. The warning can be any mode like LED light, vibrating steering or beep. This can be designed based on the type of road – for example, it will provide the driver with more slack for narrow roads or allow the driver to “cut” curves.

General Framework

The video images are captured. Captured videos are divided into frames. These frames are moved to memory for further processing after pre-processing the edge is detected from the images. Then using detection techniques like Hough transform or other methods, the lines or curves are detected and compared with the current car position. Results obtained from the lane detection module are used by decision module to determine the location of a vehicle with respect to the closest lane marking. Decision module uses lane marking on both sides of the vehicle to compute the centre of the lane and if the vehicle starts drifting away from the centre line, an alarm is triggered. To enhance the performance of lane departure system device, decision module can take input from different resources. For example, the decision module will take the inputs based on the presence or absence of the directional indicator, it can conclude whether a lane change is intentional or unintentional.
1.4 Benefits of Lane Detection:

- Gives assistance and information to drivers.
- Uniformity of the markings is a very important aspect in minimizing confusion and uncertainty approximately about their meaning.
- Allows drivers to drive vehicles safely and protect the passengers from any mishappenings.
- The warnings signal will alert the passengers also.

1.5. Limitations

Lane Departure Warning Systems and Lane Keeping Systems totally rely upon visible lane markings. They typically cannot work out on faded, absent, or inappropriate lane markings. Markings covered with snow or old lane markings left visible can hinder the ability of the system.

The analysis of the literature and existing algorithms, project that majority of these algorithms assume the conditions and situations to be close to ideal and neglect the following:

1) **Environmental Conditions**: The survey showed that the existing techniques provide good accuracy and efficiency for high-quality images but sometimes, it additionally provides negative outcomes, for environmental conditions such as fog, haze, noise, and dust.

2) **Curved Lanes Not Dealt Properly**: Most of the existing techniques work best for straight lanes, but they offer poor and inaccurate results for curved roads which won’t generate a warning at right time and may show to be fatal.

3) **Most of the lane detection techniques are based on standard Hough transforms which leaves a gap for improving accuracy.**

**Proposed System**

The proposed system should be able to detect both straight lanes as well as curved lane road images and also will be able to detect environmental conditions like fog, haze, noise, and dust and also this system should work on both day and night conditions.
<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the Paper</th>
<th>Method</th>
<th>Techniques</th>
<th>Datasets Used</th>
<th>advantage</th>
<th>Disadvantage</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A new approach to highway lane detection by using Hough transform technique</td>
<td>Lane Detection</td>
<td>Sobel filter, Hough Transform for Lane Detection</td>
<td>the video footages total 2366 frame and five scenes from the highways around Malaysia under normal driving conditions</td>
<td>Hough transform was still able to track the loss of lane marks by assuming the lane was still there by counting the number of the lost frame. If the lost track is more than the defined number of frames, then it stopped the tracking operation.</td>
<td>However, the tracked lanes cut across the vehicle during the tracking, thus, when masking was applied and the image multiplication was executed, part of the vehicle was lost. For that reason, an improvement needs to be done, especially in the lane detection part</td>
<td>true positive rate, false negative rate, false positive rate</td>
</tr>
<tr>
<td>2</td>
<td>Efficient lane detection using the hybridization of artificial bee colony &amp; modified Hough transform</td>
<td>Lane Detection</td>
<td>fuzzy c-means for Segmentation, modifying the Hough transform i.e. hybridization of additive Hough transform with artificial bee colony edge detection to detect curve lanes</td>
<td>We have taken 10 sets of various images in .jpg format.</td>
<td>In this modify Hough transform i.e. additive Hough transform with artificial bee colony based edge detector is used to get better straight lane as well as curved lane road images</td>
<td>-</td>
<td>Balanced Error Rate (BER) F-Measure Re-Call</td>
</tr>
<tr>
<td>3</td>
<td>Efficient lane detection based on artificial neural networks</td>
<td>Lane Detection</td>
<td>Ellipsoidal Neural Networks with Dendrite Processing (ENNDPs)</td>
<td>Real video taken by a camera mounted on a car circulating on an urban highway of Mexico City.</td>
<td>We have shown how the proposed methodology can be successfully applied to automatically detect lanes in urban highways.</td>
<td>The main drawback of the proposed algorithm requires more time in the filtering process. It consumes 40% of the total processing time. A possible result can be obtained by using other filtering techniques and an implementation of the algorithm in a Graphical Processing Unit (GPU).</td>
<td>Accuracy</td>
</tr>
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</table>
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<table>
<thead>
<tr>
<th>Lane Detection</th>
<th>Hough transform</th>
<th>videos of lane change as a data set</th>
<th>This system will work in both day and night situation</th>
<th>Accuracy Rate</th>
</tr>
</thead>
</table>

5 Improved Performance Of Fuzzy Logic Algorithm For Lane Detection Images

| Lane Detection | lane coloration algorithm (modifying the Hough transform i.e. fuzzy logic) | highway photograph | Fuzzy Logic is used to improve straight lane as well as curved lane road images | Area under curve, Bit Classification Rate (BCR), G_Accuracy, P_F Measure |

Conclusion:

In this paper, we have introduced the various lane detection and departure warning system. Lane detection enables one to obtain the position as well as the direction of the vehicle along with the lane information. In general, the system includes lane modelling, feature extraction, lane detection, lane tracking and departure warning modules. Based on the literature survey so far, different techniques proposed by different researcher which secured good results concerning detection rate, accuracy, and minimum false alarm rate are discussed. In spite of it still, there is a scope for lane detection and departure warning system that will have the characteristics mentioned below:

- The system should be strong i.e. it should detect lanes in all complex situations.
- Lane detection methods should be fast enough to meet real-time criteria.
- The system should detect lane departure under high vehicle departure speed with minimum false alarm.
- The system should be cost-effective.

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